EXPERIMENT-2
TUNED AMPLIFIER

(Single Tuned Amplifier)

I. Aim: To design and plot the frequency response of a single tuned amplifier.

II. Objectives:

1. Design a single tuned amplifier for a given specifications.
2. Simulate the designated single tuned amplifier.
3. Develop the hardware for designated amplifier.
4. Obtain the frequency response for designated amplifier.
5. Compare the software and hardware results that are obtained.

III. Specification: Operating Frequency of the Circuit = 10 kHz.

IV. Hardware:
a. Silicon-NPN-transistor BC107
b. Resistors:18.3kΩ,6.8kΩ,1kΩ
c. Inductors:3mH
d. Capacitors:0.1μF,10μF,100μF
e. CRO
f. Function Generator
g. Bread board

V. Theory:

About Tuned Amplifier:

Tuned Amplifiers are high frequency circuits designed to have a very narrow bandwidth and a voltage gain that peaks at a particular frequency. To produce these characteristics the amplifier uses a resonant parallel LC circuit (or tank circuit) as a BJT Collector load, this gives the amplifier a high voltage gain at the resonant frequency of the tank circuit.

A single tuned amplifier consists of only one LC section as a load.
A double-tuned amplifier is a type of radio frequency (RF) amplifier that utilizes two resonant circuits or tuned circuits to achieve narrowband amplification. It is commonly used in RF and microwave applications where selectivity and high gain are essential.

A stagger-tuned amplifier is a type of radio frequency (RF) amplifier circuit designed to provide selective amplification of signals within a certain frequency range. It consists of multiple amplifier stages, each tuned to amplify a specific range of frequencies. These stages are staggered in frequency.

VI. Procedure:

a. Connect the circuit as per the circuit diagram
b. Apply 10mV pk with 52KHZ frequency using function generator{Software}
   Apply 100mV p-p with 1KHz initially, slowly increase the frequency of Input Signal.
c. Observe the output in CRO.
d. Note output Vp-p and frequency for max Amplitude in Observation Table.
e. Plot Frequency Response from Observations.

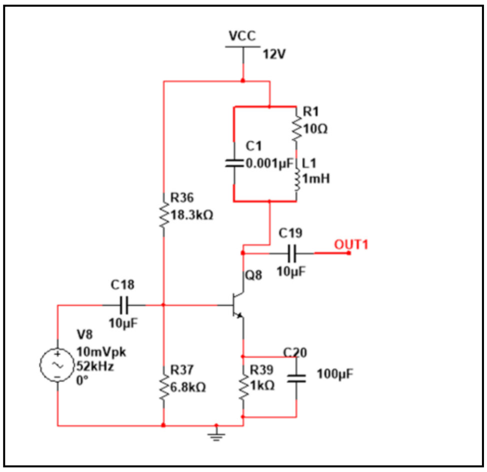
VII. Design:

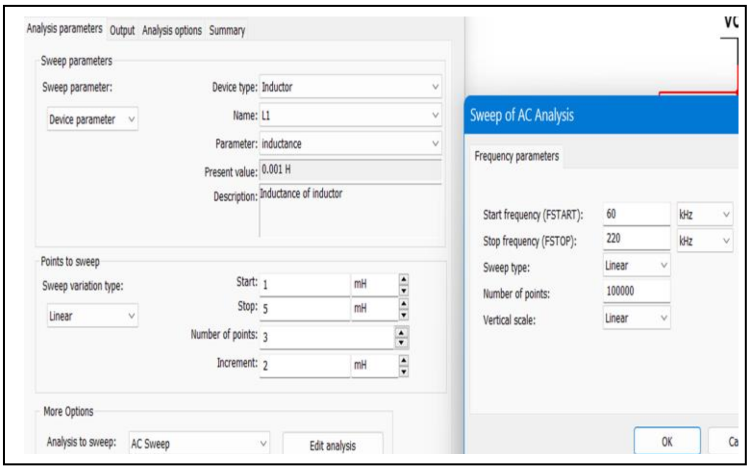
$$Fc = \frac{1}{2\pi\sqrt{(LC)}}$$

C=0.1μF, L~=3mH, Fc = 10KHz
C=0.1μF, L~=30μH, Fc = 100KHz

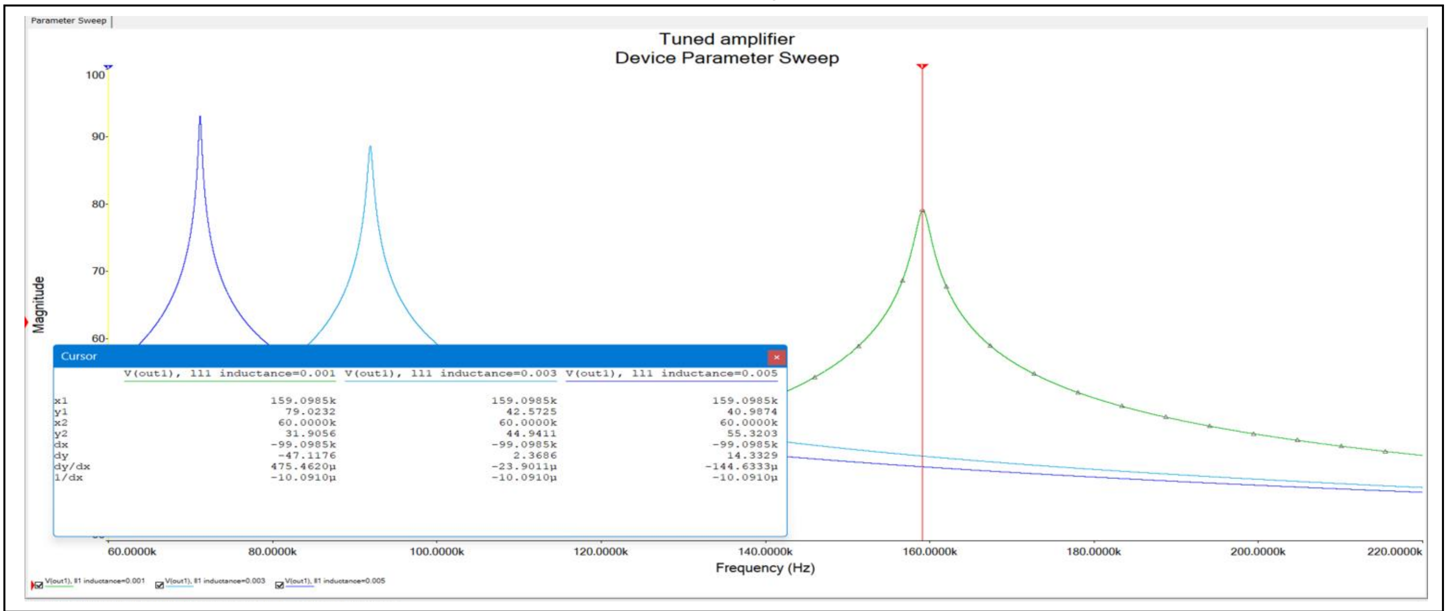
VIII. Simulation Observations:

a. Single Tuned Amplifier:

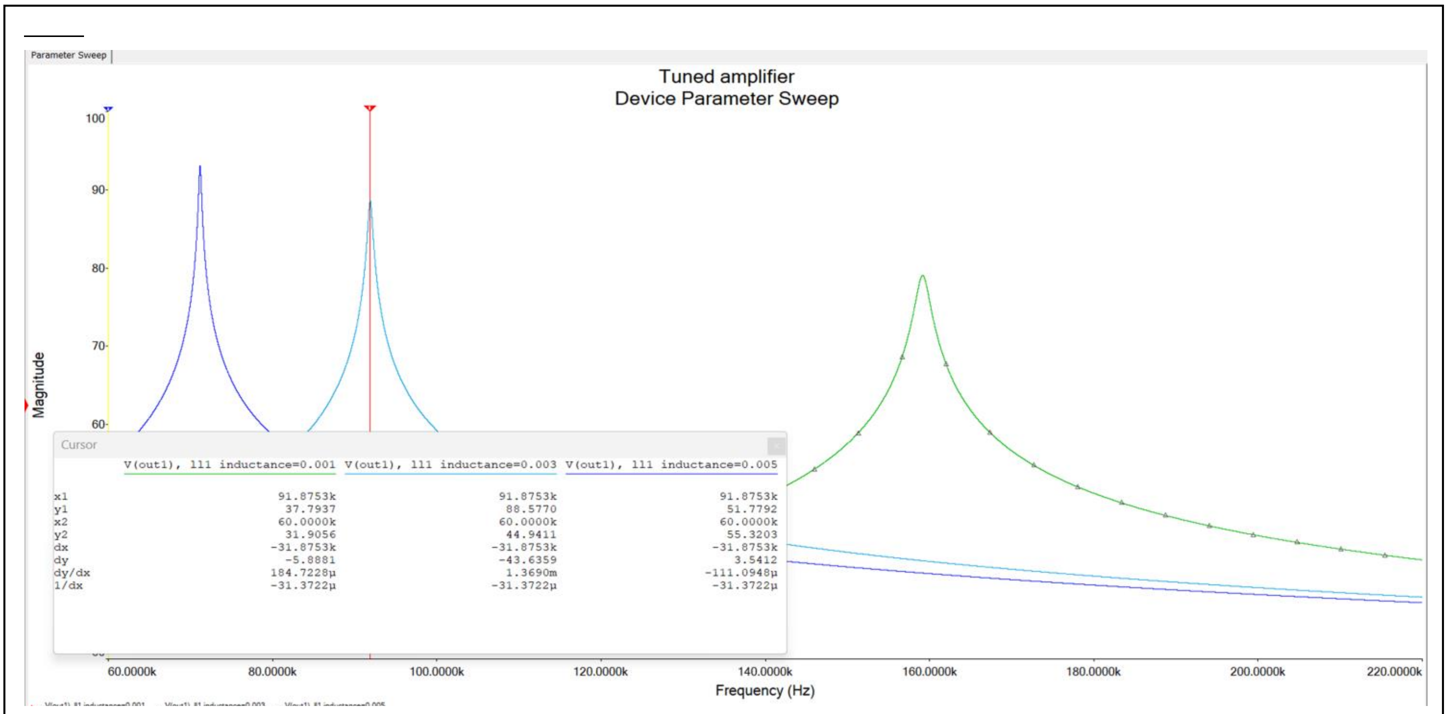




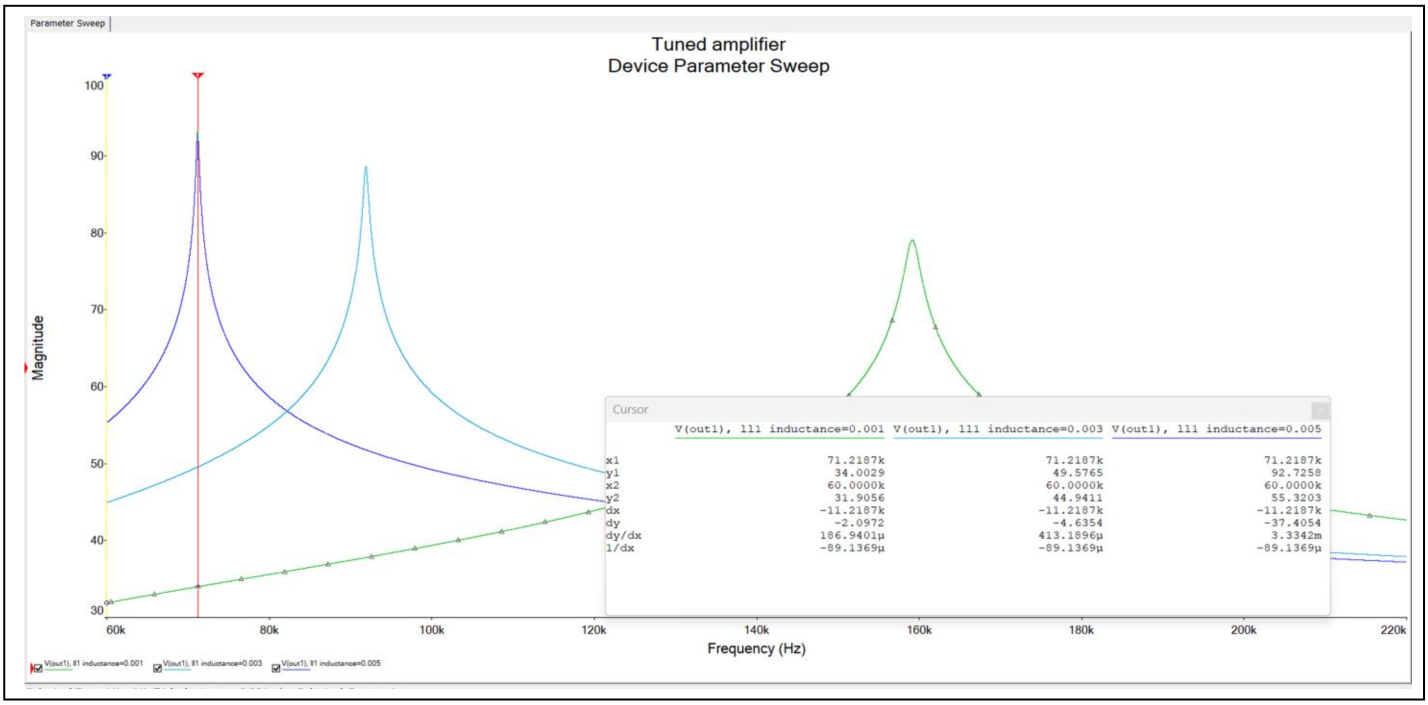
For L=1mH



For L=3mH

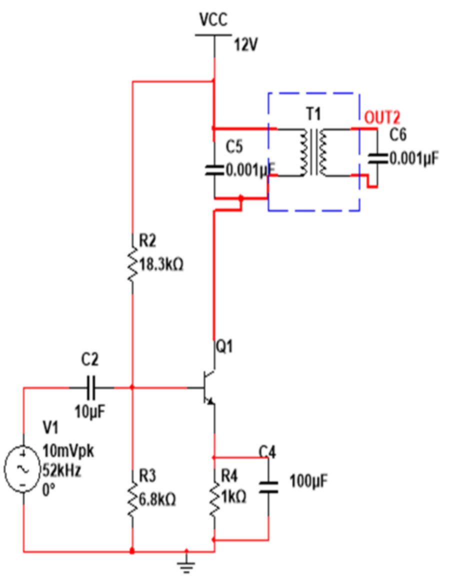


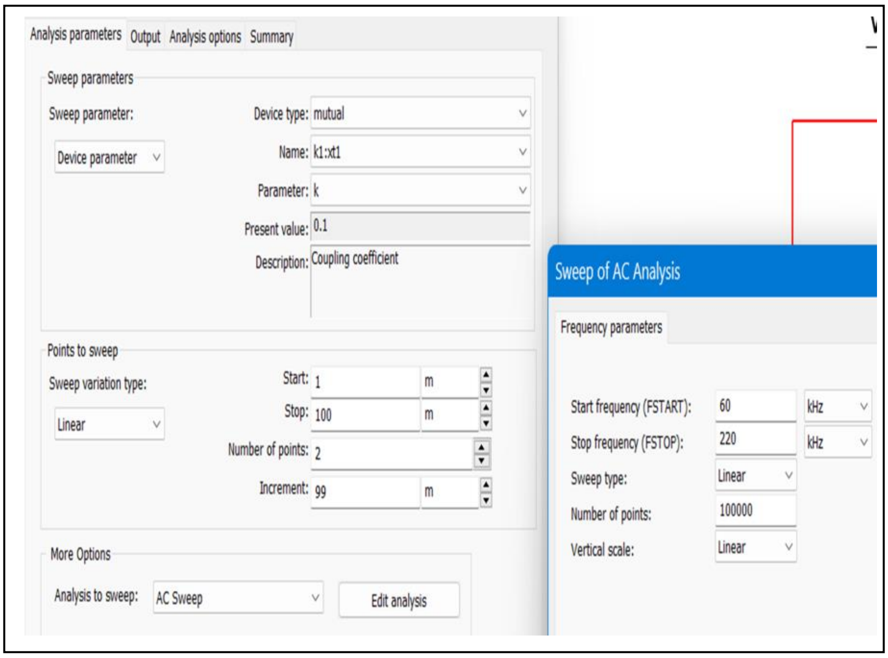
For L=5mH



From the theoretical calculations, we can observe that as the inductance (L1) increases from 1mH to 5mH the resonant frequency is decreasing. Hence the circuit offers good selectivity as the resonant frequency is limiting. Hence if we want to decrease the resonant frequency we can increase the inductance values if we want to increase resonant frequency we can simply increase it by decreasing inductance value.

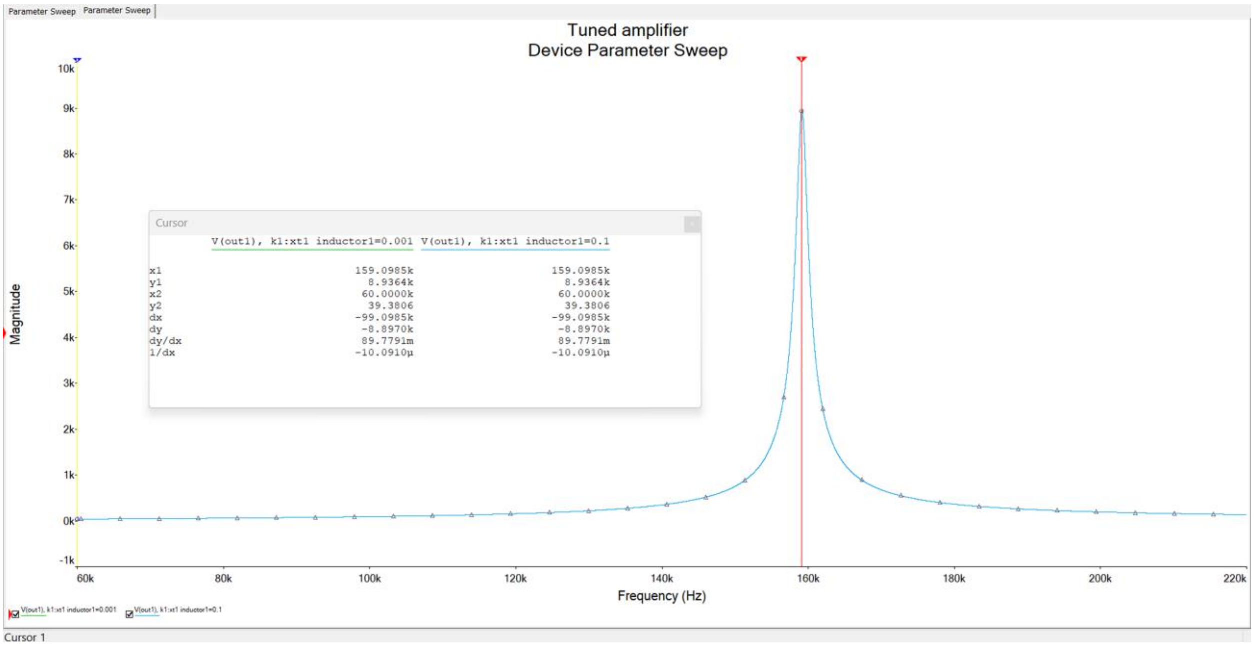
b. Double Tuned Amplifier:



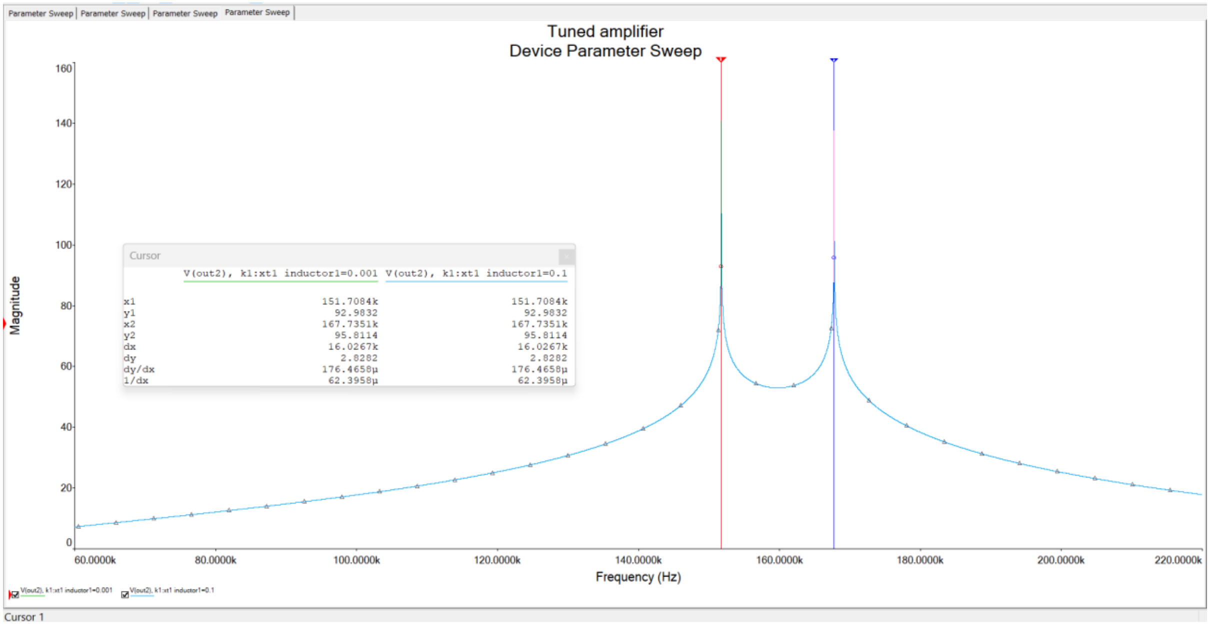


Bandwidth=k*f Where k=coefficient of coupling.

When k=0.001



When k=0.1



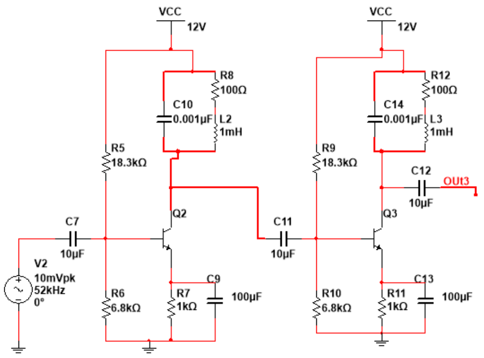
It offers better selectivity and bandwidth compared to single-tuned amplifiers.

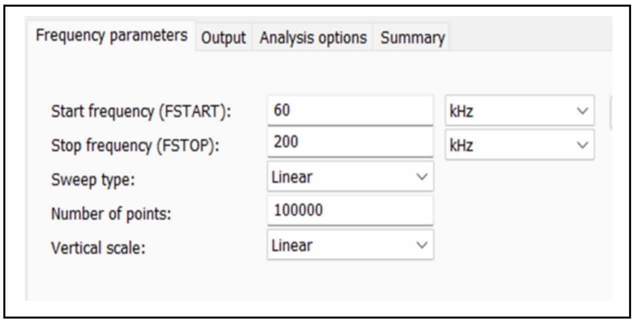
The two tuned circuits provide additional tuning stages, which improve the amplifier's ability to reject unwanted frequencies while amplifying the desired ones.

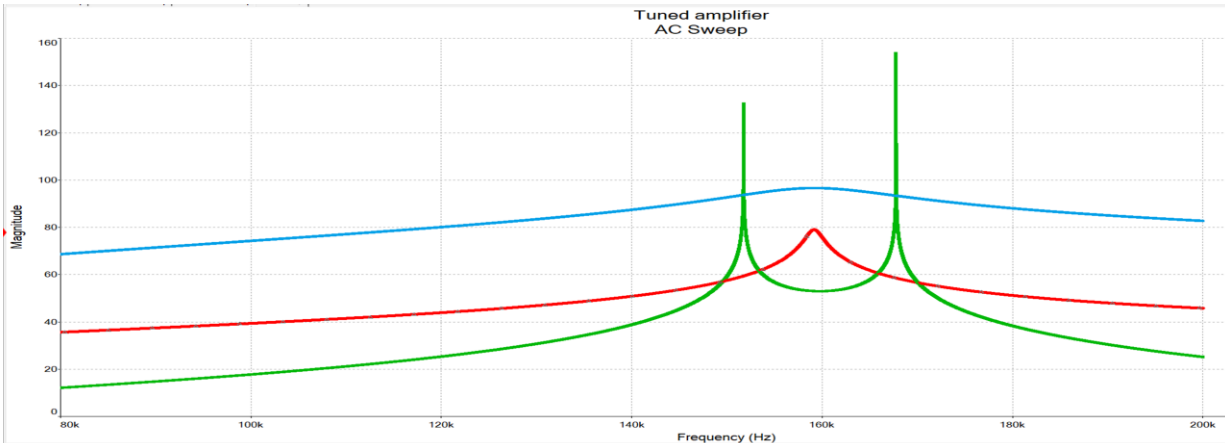
k = 0.001 => Loose coupling, k = 0.1 => Tight coupling

The peaks of the central frequency is dependent on the value of k.

c. Stagger Tuned Amplifier:







This staggering of resonant frequencies helps to mitigate the effect of tuning component tolerances and improves the flatness of the frequency response. Stagger-tuned amplifiers offer improved performance over double-tuned amplifiers in terms of frequency response linearity and stability.

<u>Frequency Response:</u>

At L=3mH:

FREQUENCY(HZ)	**INPUT(v)**	**OUTPUT(v)**	**GAIN in db**
1K	50m	169m	24.35
2K	50m	221m	29.72
3K	50m	362m	39.59
4K	50m	342m	38.45
5K	50m	460m	44.38
8K	50m	1.29	65
9.1K	50m	4	87.64
9.79k	50m	6.6	97.65
10k	50m	3.5	84.96
13k	50m	1	59.91
16k	50m	800m	55.45
18k	50m	600m	49.69
20k	50m	500m	46.05

At L=30uH

FREQUENCY(HZ)	INPUT(V)	OUTPUT(V)	GAIN in db
90K	50m	480m	45.23
92K	50m	1.15	62.7
93K	50m	563m	48.42
95K	50m	430m	43.03
100K	50m	310m	36.49
102K	50m	275m	34.09

Result:

RESONATING FREQUENCY (single tuned amplifier(L=3mh)	
Theoretical	9.19 khz
Practical	9.529 khz

RESONATING FREQUENCY (single tuned amplifier(L=30mH)	
Theoretical	91.9 khz
Practical	92.5 khz

Signature of the Faculty